



EFFECT OF COMPUTER-AIDED-INSTRUCTION ON SECONDARY SCHOOL STUDENTS' ACHIEVEMENT IN ORGANIC CHEMICAL NOMENCLATURE

Dr. Ogwu Comfort Ngozichukwuka
Department of Science Education
ESUT, Enugu.

ABSTRACT

Secondary school students' achievement in chemistry has been deteriorating over the immediate past years. The rate at which students' achievement in chemistry is decreasing coupled with its negative effect on technology should be a matter of concern to Nigerians, including the world of science. This was attributed to lack of fundamental knowledge in chemistry known as Organic Chemical Nomenclature (OCN). One of the major reasons why students lack such relevant knowledge was as a result of poor achievement due to use of ineffective method of teaching known as Expository Method of Instruction (EMI). It was based on that backdrop that the study determined to study the effect of Computer – Aided Instruction (CAI) on secondary school students' achievement in OCN. Quasi-experimental design was adopted for the study. Pretest-Posttest, non-equivalent control group was used. 8 intact classes, 4 of which were randomly assigned to experimental and other 4 to control groups were used for the study. Sample of the study consist of 122 males and 186 females (308) senior secondary one (SS1) chemistry students from 4 government owned secondary schools in Enugu Education Zone of Enugu State. 2 research questions and 2 hypotheses guided the study. Teacher made organic chemical nomenclature achievement test (TEMOCNAT) was used for data collection. TEMOCNAT was constructed by the researcher and validated by 5 research experts. Mean and standard deviation were used to answer the research questions while the hypotheses were tested at 0.05 level of significance using Analysis of Covariance (ANCOVA). Experimental group was taught using CAI while control group was taught the same topic using EMI. The major findings of the study revealed that students taught OCN with CAI achieved higher than those taught with EMI. There was no significant interaction effect on CAI and gender, males and females achievement were almost the same. It was recommended that chemistry teachers should employ CAI in teaching OCN to improve students' achievement and promote gender equality.

Keywords: Computer Aided Instruction, Organic Chemical nomenclature and achievement.

INTRODUCTION

In Nigerian secondary schools, students' achievement in chemistry over the years has not been encouraging. The West African Examinations council (WAEC) Chief Examiner's reports (2008-2012) showed that Nigerian students' achievements in West African School Certificate Examination in chemistry were poor. Inadequate knowledge in organic chemical nomenclature (OCN) is one of the main factors pointed out that contributed to students' poor achievement in chemistry (Ogwu, 2021). Organic chemical nomenclature is defined as the system of naming a hydrocarbon. A hydrocarbon is an organic chemical



compound composed of carbon and hydrogen atom only. They have the general formulae C_xH_y , where x and y are positive whole numbers (Odesina, 2008). Gbamanja (1991) mentioned that chemistry teachers use Expository Method of Instruction to impart this knowledge. Expository Method of Instruction is defined as chalk, chalkboard and talk method of Instruction which makes learning of chemistry concept (OCN) abstract and ineffective. As a result, students tend to develop phobia for the study of chemistry (Ogwu, 2021). Students' achievement in chemistry over the years becomes abysmally poor.

For students achievement in chemistry to improve there must be a call for change of teaching method from Expository to innovative approach. One of such innovative teaching method is the use of Computer-Aided Instruction (CAI). Depending upon the relative degree of involvement by the learner, two types of CAI were identified by (Adegbenro cited in Obodo and Ogbu, 2013) one was passive CAI which involves the use of computer as teaching/learning aid, but there is no direct involvement by students. The other was interactive CAI that promotes active learning in which there are high degree of students' participation and involvement. Philip (2005) opined that each of the two types of CAI may be used at different levels, For instance, at the initial stage of introducing a new topic, passive CAI could be useful. On the other hand, interactive CAI could be useful in learning by discovery situation. Here, interactive CAI was adapted in this study. It is defined as an interactive instructional technique whereby a computer is used to teach organic chemical nomenclature, monitor and discover the learning that takes place (Rieber, 2004). It is an innovative teaching method which has mechanisms that enhances the discovery of scientific environment (Ried, Hang, and Chen, 2003), transform learner's alternative conception (Jimoyiannis and Komis, 2001), and support a collaborative environment (Milrad, 2002). CAI with its efficacious mechanisms such as Personalization of information, Animation, Fantasy context and Practice activity help students to construct structural models of organic compounds, visualize features in the structures of the models and analyze their actions with the use of concretize concept which support collaborative learning environment that revamps students achievement. CAI is a programmed instruction that present organic Nomenclature course- material, ask questions and check answers, varying its presentation on the basis of the students' response (Mehrotra. 1985 in Ogwu, 2021). It uses different learning styles to teach, evaluate, disseminate and update educational information. Learning with interactive CAI, students can comment on what they see, hear or revisit/reinspect things studied, thus promoting their achievement.

CAI is theoretical based under six theoretical foundations of learning. They are Subsumption theory, Foundational theories, Cognitive multimedia theory, Multimedia theory, Foundation theory for game and Behaviourist theory. The theoretical frame work examined the relevance of the above learning theories to the study. The six learning theories mentioned above gave justification that CAI model of instruction had capability of developing students' knowledge on structural drawing , understand rules guiding naming of organic compounds as well as improving their achievement in OCN (Ogwu, 2021). The word 'achievement' implies scholastic standing of a student at a given period



which shows the individuals intellectual abilities (Adeyemi, 2008). Achievement is mainly assessed with achievement tests. Schnitzer (2005) defines achievement tests as tests design to assess recent students' achievement in chemistry. Apart from being an indicator of previous learning, Schnitzer sees achievement as predictor of future academics success. In Nigerian secondary schools the level of students' academic achievement is determined at the terminal part of the programme through the West African Senior School Certificate Examination (WASSCE), conducted by the West African Examinations Council (WAEC) and the Senior School Certificate Examination (SSCE), conducted by the National Examinations Council (NECO). Chief WAEC Examiners report over some years show that students' weakness in OCN is one of the major causes of students' failure at the senior school certificate examination on chemistry.

In considering the efficacy of Computer- Aided Instruction on students' achievement, gender as a variable was considered as factor that influenced secondary school students' achievement in chemistry. Meanwhile the influence of gender on student's achievement has for a long time been of concern to many researchers but no consistent result has been established in science. Nebo (2012) opined that there is no significant difference in the achievement of male and female students taught Biology using learning activity package (LAP). But, Mbamalu (2009) stated that there is significant difference between mean achievement scores of boys and girls taught Propagation of light (POL) with analogy, conceptual change and guided discovery instructional models respectively. However, Iloputaife (2001) in Mbamalu (2009) suggested that there is no significant difference in the mean Physics achievement concept scores of boys and girls taught simple electric circuit in Physics. Following the foregoing findings, no study known to the researcher has been done to ascertain its relative effectiveness in chemistry, especially OCN. One good way of effecting a change of method in teaching a particular subject is to demonstrate empirical evidence that such method can yield positive instructional outcomes. Without empirical evidence to support its effectiveness in revamping students' achievement in OCN it may be ignored. It is based on this that this study intends to find out the effect of Computer-Aided Instruction (CAI) on secondary school students' achievement in Organic Chemical Nomenclature (OCN).

PURPOSE OF THE STUDY

The purpose of this study was to determine the effect of Computer-Aided Instruction (CAI) on SS1 chemistry students' achievement in Organic Chemical Nomenclature (CA).

Specifically this study sought to determine the

1. Effect of Computer-Aided Instruction (CAI) on SS1 chemistry students achievement in organic chemical nomenclature (OCN).
2. Interaction effect of CAI and gender on SS1 chemistry students' achievement in organic chemical nomenclature (OCN).



RESEARCH QUESTIONS:

The following research questions guided the study.

1. What is the mean achievement score of SS1 chemistry students taught organic chemical nomenclature (OCN) using Computer-Aided Instruction (CAI)?
2. What is the interaction effect of CAI and gender on SS1 chemistry students' achievement scores in organic chemical nomenclature (OCN)?

HYPOTHESES

The following null hypotheses guided the study and were tested at 0.05 level of significance.

- HO₁: There is no significant difference in the mean achievement scores of SS1 chemistry students exposed to Computer-Aided Instruction (CAI) and those not exposed to in organic chemical nomenclature (OCN).
- HO₂: There is no significant interaction effect of CAI and gender on mean achievement scores of SS1 chemistry students in organic chemical nomenclature (OCN).

METHOD

This study employed quasi-experimental research design. The specific design used was a non-equivalent, control group, pre-test, post-test design. The study was carried out in Enugu Education zone. There are three local government areas in Enugu Education zone. These are Enugu-East, Enugu-North and Isi-Uzo. The local government Areas has 24 government secondary schools, 16 of which are mixed sex, while 8 are single sex schools. The population for the study consists of all the two thousand, seven hundred and thirty-four (2,734) SS1 chemistry students in Enugu Education Zone in Enugu State, as at 2012/2013 academic section (Source: Statistical of the Post Primary Schools Management Board, Enugu, 2019).

The sample for the study consists of all the 308 SS1 chemistry students in the eight intact classes which were from 4 schools randomly sampled by balloting without replacement from 24 government schools in Enugu Educational Zone in Enugu state. The four schools were further purposively sampled into males (122) and females (186) SS1 chemistry students due to variable gender, including schools that have computer. 61 males and 93 males were assigned to experimental group taught with CAI instructional model while 61 males and 93 females were assigned to control group taught with EMI instructional model of instruction. Instruments used for data collection were teacher made organic chemical nomenclature achievement test (TEMOCNAT) for control group and TEMOCNAT software package for Experimental group. The instruments were developed by the researcher. It is made up of twenty (20) multiple choice questions. The items were drawn using a test blue-print to ensure adequate coverage of the content areas as well as maintain even spread across the different levels of the cognitive domain. The items were analyzed and validated based on spread of question items, level of difficulty and type of questions such that the items meet the requirements of the test blue print.



The TEMOCNAT was face and content validated by five experts, one from measurement and evaluation, one from computer program, one from chemistry education programme and two chemistry teachers from the sampled schools. TEMOCNAT was trial-tested using 40 students in Udi Educational Zone. The internal consistency reliability was obtained using Kuder- Richardson's formula 20 (KR-20). A reliability coefficient of 0.87 was obtained.

The researcher trained the four regular chemistry teachers as research assistants in the four sampled schools used in the study for one week on administration of the instrument (TEMOCNAT). The experimental group was taught with CAI method while the control group was taught with EMI method. Before the study started PRE- TEMOCNAT was administered to all the subjects as pretest. After the pretest, the research assistants trained by the researcher started the experiment. The achievement test (Pre- TEMOCNAT) software package for the experimental group taught with CAI was restricted with time by logging off computers after the pretest and administered as POST-TEMOCNAT for Posttest. The PRE-TEMOCNAT for the control group taught with EMI after pretest were reshuffled and administered to the subjects as POST-TEMOCNAT for Posttest. The teaching lasted for a period of six weeks. The Posttest items were scored 100marks (5marks each). Student that gets the 20 items right scored 100 but for the student that failed the 20 items scored zero. The scores collected from the pretest were kept alongside the post-test achievement scores.

Mean and standard deviation were used to answer the research questions while analysis of covariance was used to test the hypotheses at .05 level of significance.

RESULT

The result of this study is presented in the table according to the research questions and hypotheses that guided the study.

Research question one

1. What is the mean achievement score of SS1 chemistry students taught organic chemical nomenclature (OCN) using Computer-Aided Instruction (CAI)?

Table 1: Mean and Standard deviation of students' achievement in organic chemical nomenclature (OCN).

Methods	N	Pretest		Post-test		Mean Gain Score	Mean Gain Difference
CAI (Experimental Group)	154	Mean 33.18	SD 1.06	Mean 81.98	SD 0.36	48.80	42.79
EMI (Control Group)	154	23.34	1.05	29.35	0.76	6.01	



Table 1 shows that, the experimental group had a pretest mean achievement score of 33.18 with deviation of 1.06 and a post-test mean achievement score of 81.98 with standard deviation of 0.36. On the other hand, the pretest achievement score of the control group was 23.34 with standard deviation of 1.05, while their posttest mean achievement score was 29.35 with standard deviation 0.76. The experimental group had a mean gain of 48.80 as against the mean gain score of 6.01 recorded by the control group. The experimental group achieved higher than the control group with 42.79 gain score, indicating that CAI is highly more effective than EMI. Apparently, the standard deviation values in the posttest for experimental group is lower than the control group indicating that the mean of the experimental group is more reliable than the control group which is a true representation of the group ability.

Research Question Two

What is the interaction effect of CAI and gender on the SS1 chemistry students' achievement scores organic chemical nomenclature (OCN)?

Table 2: Mean and Standard deviation of interaction effect of CAI and gender on the SS1 chemistry students' achievement scores in organic chemical nomenclature (OCN)

Methods	GENDER		
		Male	Female
Experimental group	N	61	93
	X	82.5	81.61
	SD	2.57	4.77
Control group	N	61	93
	X	29.84	29.03
	SD	3.32	3.70

Table 2 presents the data on the interaction effect of CAI and gender on students mean achievement scores in organic chemical nomenclature (OCN). The table indicates that the males in the experimental group had a mean score of 82.5 as against the mean score of 29.84 recorded by their counterparts in the control group. The females in the experimental group had a mean score of 81.61 ahead of their counterparts in the control group, who had 29.03. The results showed that the males in the experimental group achieved higher than the males in the control group, while the females in the experimental group achieved higher than the females in the control group. The superiority of the scores of males and females in the experimental group over those of the males and females in the control group could be attributed to the effect of treatment alone and not from the interaction effect of CAI and gender. The scores of males and females in the experimental group were almost the same.



Hypotheses

Hypothesis One

H₀₁: There is no significant difference in the mean achievement scores of SS1 chemistry students exposed to Computer-Aided Instruction (CAI) and those exposed to Expository Method of Instruction (EMI) in organic chemical nomenclature (OCN).

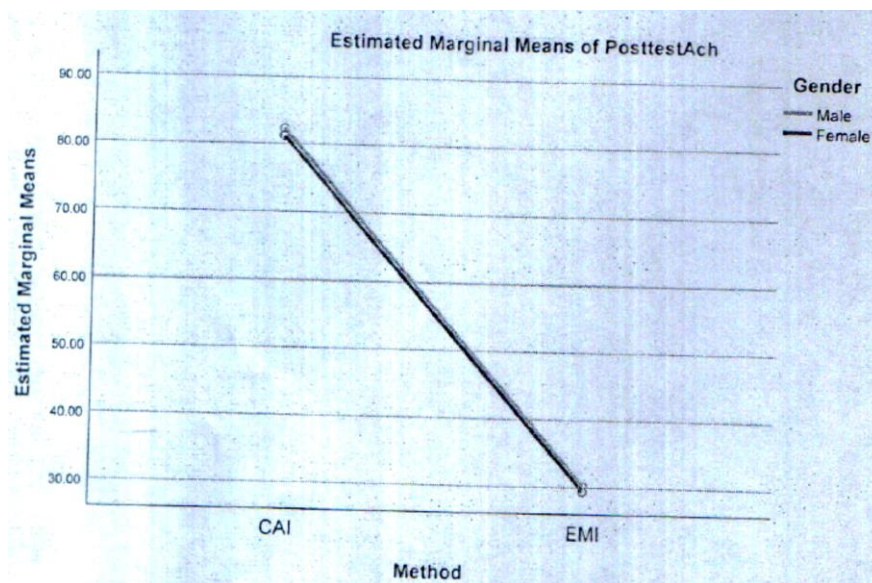
Table3: Summary of Analysis of covariance (ANCOVA) of SS1 chemistry students mean achievement score in organic chemical nomenclature (OCN) when exposed to Computer-Aided Instruction (CAI) and those exposed to Expository Method of Instruction (EMI).

Source	Type 11 sum of squares	DF	Mean square	F	Sig	Partial Eta square
Corrected Model	213698.735 ^a	4	53424.684	283.548	.000	
Intercept	168981.615	1	168981.615	896.857	.000	
Pretest Ach	360.656	1	360.656	1.914	.168	
Method	177659.312	1	177659.312	942.914	.000	.757
Gender	70.013	1	70.013	.372	.543	.001
Method * Gender	1.722	1	1.722	.009	.924	
Error	57089.820	303	188.415			
Total	1225175.000	308				
Corrected Total	270788.555	307				

Result shown on table 2 indicates that treatment as a main effect has a significant effect on the students' achievement in organic chemical nomenclature (OCN). This is because the F value of 942.914 in respect of treatment is shown to be significant at 0.000 level, which is less than 0.05 level set for the study. This means that at 0.05 level, the F value of 942.914 is significant. Hence, CAI has significantly improved students achievement in OCN more than the EMI. Thus, the null hypothesis that there is no significant difference in the mean achievement scores of students taught OCN using CAI and those taught with the EMI is rejected.

Hypothesis Two

H₀₂: There is no significant interaction effect of CAI and gender on mean achievement scores of SS1 chemistry students in organic chemical nomenclature (OCN).



The interaction effect of CAI and gender as shown in Table 2 is not significant. This is because the calculated F value of 0.009 in respect of interaction effect between CAI and gender on students' achievement in OCN is shown to be significant at 0.924 level which is greater than 0.05 level set for the study. Consequently, the null hypothesis is not rejected, indicating that there is no significant interaction effect of CAI and gender on students mean achievement scores in organic chemical nomenclature. The graph further shows that there is no significant interaction effect on CAI and gender observed, the mean achievement scores of male and female students taught organic chemical nomenclature were almost the same.

Summary of Findings

Here is the summary of findings made in this study:

1. The CAI has significant effect on students' achievement in OCN. The group taught with CAI achieved significantly higher than the group taught with expository method of instruction.
2. Gender has no significant influence on male and female students' achievement in organic chemical nomenclature.

Discussion of Findings

Evidence from the results of data analysis has shown that the Computer-Aided Instruction significantly improved students' achievement in organic chemical nomenclature more than the Expository Method of Instruction. This is based on the fact that the students taught with CAI scored significantly higher on the achievement test than their counterparts taught



with EMI. The result of this study is in tandem with earlier finding of Hounshell (1996) which stated that students in CAI scored significantly higher on the achievement test than EMI group in practical chemistry. Supported by the finding of Sherwood (2001) which states that CAI offer a long term cumulative effect on students understanding. This is as a result of providing varieties of colour, text and appealing photographs which simplify complicated topics (Bushong, 1998), students retain information better (Tornabene, 2004) and achieved more. Based on these results and findings in students level of understanding, poor achievement in chemistry examinations might be affected by the role of CAI model of Instruction.

The result also showed that, the difference in the mean achievement score of male and female students taught organic chemical nomenclature with CAI and EMI was not statistically significant. Thus, the null hypothesis that gender has no significant effect on the mean achievement scores of male and female SS1 chemistry students taught organic chemical nomenclature was upheld. The result further showed that the efficacy of CAI teaching method improved the achievement of students (males & females) taught OCN and promote gender-equity. This finding is in accordance with (Seymour, 2001) which states that gender balance should be promoted by teachers implementing gender-inclusive chemistry instructional strategy CAI that is not gender biased, addressed boys and girls short coming and eliminates the harassment that inhibits girls learning. In agreement with the finding of Sayre (2001) found that CAI (Animation) has the ability of representing learning materials using pictorial form and verbal form such as spoken and printed text. Through it, instructions are analyzed through motion, voice, text graphics and images. This increases males and females thinking ability, analytical skill and understanding; helps improve the academic achievement of boys/girls in chemistry through stimulating more than one sense at a time, attention getting and gaining (Reeves, 1998).

CONCLUSION

CAI is fast penetrating into all level of education throughout the whole world. This model of instruction is used in teaching subjects such as English, Mathematics, Business studies and Biology etc. It is essential that we move with the technological trends by using CAI in delivering chemistry instruction especially OCN. Chemistry teachers should employ CAI to improve students' achievement and promote gender-equity in science, especially chemistry (OCN).

RECOMMENDATIONS

Based on the findings of this study, the following recommendations are made; Nigerian secondary school chemistry teachers should adopt CAI as an alternative to the EMI in teaching organic chemical nomenclature. Governments and Organizations (MTN or GLO) should equip secondary schools with necessary information and communication technology (ICT) facilities to educate students in the topic organic chemical nomenclature



(chemistry). Stockholders in science especially in chemistry should employ CAI to improve student's achievement and promote gender-equality.

REFERENCES

- Adeyemi, T. O. (2008) Predicting students' performance in Junior secondary certificate Examination Ondo State, Nigeria. *Humanity and Social Science Journal*, 3 (1), 26-36.
- Bushong, G. (1998) The utilization of power point presentation in integrated science instruction. *Journal of Education Psychology*, 14 (12), 84-87.
- GBamanja, P.T. (1991) Modern methods in science education in Africa, Owerri: Totan Publishing, Ltd.
- Hounshel, P.B.(1996) The microcomputer achievement and attitudes in high school Biology. *Journal Research in Science Teaching*. 20 (6), 543-549.
- ILoputaife, E. C. (2001) Effect of Analogy and Conceptual change models on Physics Achievement In secondary schools. *Unpublished Ph. D thesis*, Nsukka, University of Nigeria. Jimoyiannis, A. and Komis, V. (2001) Computer simulation in Physics teaching and Learning: a Case study on students' understanding of trajectory motion. *Computer and Education*, 36, 183-204.
- Mbamalu, O. J. (2001) Comparative effects of three modern instructional strategies on senior Secondary schools students Physics Achievement and reasoning. *Unpublished Ph. D thesis*, ESUT, Enugu.
- Mehrotra, R. C. (1985) The use of Computer in teaching science at secondary level. *Journal of Higher Education*. 1, 31.
- Milrad, M.(2002) Using Construction Kits, modeling tools and system dynamics simulations to Support collaborative discovery Learning. *Educational Technology and Society*. 5 (4), 1-18.
- Nebo, O. (2012) Effect of learning Activity Package (LAP) on male and female students Achievement in secondary school Biology. *Journal of science and Computer Education (JOSCED)*, 2, (1), 1-14.
- Obodo, G. C. and Ogbu, S. (2013) An Evaluation of the use of use of Computer-Assisted Instruction (CAI) in teaching secondary school Mathematics in Enugu State. *Journal of studies in Education*, volvi, No 1, Oct, Pg 228.
- Odesina, I. A. (2008) Essential chemistry for senior secondary schools. (2nd Ed.) Tonad Publishing Limited, Ibafo.
- Ogwu, C. N. (2021) Effect of Computer-Aided Instruction on students' interest and achievement In organic chemical nomenclature, content of senior secondary school certificate chemistry. *Unpublished Ph.D Education Thesis* ESUT, Enugu.
- Philip, B. (2005) Author languages for Computer Aided Learning. London: Macmillian Education Ltd.



- Reeve, T. (1998) The impact of Media and Technology in schools: *A research report prepared for The Bertelsmann Foundation (online)*.
- Rieber, L.P. (2004) Using Computer Animated graphics with science instruction with children. *Journal of Education Psychology*; 82, 132-140.
- Reid, D. J; Zhang, J. and Chen, Q. (2003) Supporting Scientific discovery learning in a simulation Environment. *Journal of Computer-Assisted learning*, 19, 9-20.
- Sayre, T. (2001). The Smart classroom versus the Traditional classroom what the students are saying? *Journal of Research in Science Teaching*. 17 (2), 75-81.
- Seymour, E. (2001) Tracking the Processes of change in US Undergraduate Education in Science, Mathematics, Engineering and Technology. *Science and Education*. 86 (1), 79-105.
- Schnitzer, T. (2005) Achievement in the first 2 years of school: Pattern and Processes. *Monographs of society for research in children development*, 53, 27-42.
- Sherwood, R. (2001) The effect of students manipulation of molecular models on chemistry achievement according to Piagetian level. *Journal of research in science teaching*, 12 (1) 75-81.
- Tornabene, M. (2004) Participating multimedia learning, engaging learning Australian. *Journal of Education Technology*, 21 (3) 7-9.
- WAEC Chief Examiners Report Nigeria on Senior School Certificate Examination, (2011). The West African Examination Council Test Development Division, Yaba, Lagos. Nov/Dec.